Adult Age Differences in Source Recall: A Population-Based Study

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Age differences in source recall were investigated in a population-based sample of healthy adults aged 35 to 80 years (N = 1000). Participants, who were screened on a variety of demographic, psychological, and biological variables, studied facts about well-known and unknown persons that were presented in four different ways, depicting four different sources of item information. An age-related deterioration of both item and source recall was observed, with source recall being more impaired than item recall. Source error analyses revealed an increase of source amnesia in subjects aged 75–80 years. Individual differences in background variables, age, gender, and word comprehension were related to source recall of well-known items, whereas age and years of formal education were related to source recall of unknown items. Source amnesia was accentuated in the two oldest cohorts and related to word comprehension. The age-related tendency to forget the source even when the fact is retained is suggested to be a specific feature of cognitive aging.

Contextual information is essential for episodic remembering because it can be used to distinguish among instances of a common theme of experienced episodes. This means that memory of specific attributes of an earlier event serves as an important means by which that particular episode is remembered and differentiated from other similar events. Considering older adults’ memory problems from this perspective, one possible reason for age-related differences in episodic memory is that older adults treat contextual information differently than their younger counterparts. Specifically, several studies indicate that older adults show a tendency to encode information in a rather general, prototypical manner (Burke & Light, 1981; Craik & Simon, 1980; Mäntylä & Bäckman, 1990; Mäntylä & Craik, 1993; Rabiniowitz & Ackerman, 1982; see also Craik & Jennings, 1992). Hence, given that aging is associated with increments in general encoding (at the expense of specific event attributes), older adults might be expected to exhibit difficulties in remembering the source of the original event.

Consistent with this notion, several studies suggest that tasks requiring only activation of preexisting memory representations show minimal age effects, whereas tasks requiring integration of contextual information are more age sensitive (Balota & Duchek, 1988; Howard, McAndrews, & Lasaga, 1981; Hultsch, Masson, & Small, 1991; La Voie & Light, 1994; Light, Singh, & Capps, 1986; see also Light, 1991). Typically, older adults appear to have more difficulties than younger adults in remembering the source of the information they learned earlier. For example, elderly people have more trouble than younger adults in remembering whether information was presented auditorily or visually (Lehman & Mellinger, 1984; McIntyre & Craik, 1987), in a male or a female voice (Kausler & Puckett, 1981), in upper or lower case letters (Kausler & Puckett, 1980), or in a particular color (Park & Puglisi, 1985).

Furthermore, studies that have adopted the reality-monitoring approach (Cohen & Faulkner, 1989; Ferguson, Hashtroudi, & Johnson, 1992; Hashtroudi, Johnson, & Chrosniak, 1989; Hashtroudi, Johnson, Vnek, & Ferguson, 1994; see also Johnson, Hashtroudi, & Lindsay, 1993, for a review) indicate that older adults are impaired relative to young adults under some task-monitoring conditions (but see also Kausler, Lichty, & Freund, 1985; Mitchell, Hunt, & Schmitt, 1986). For example, Hashtroudi et al. (1989) used three types of source monitoring tasks, namely discriminating between externally derived and internally generated memories, discriminating between two types of internally generated memories, and discriminating between two types of externally derived memories. Hashtroudi et al. (1989) found that, relative to younger adults, older adults had more difficulties in discriminating memories of the same class (internal-internal and external-external) but not between different classes of memories (external-internal). The authors interpreted these findings to indicate that older adults have a specific rather than a general deficit in remembering the source of information” (Hashtroudi et al., 1989, p. 110).

A central issue in this context is whether or not memory for source is selectively disrupted by aging. In other words, are age-related differences in source recall qualitatively different from other aspects of episodic remembering, so that source recall is especially age sensitive? Alternatively, there is a possibility that age differences in source recall are similarly impaired in relation to item memory, which in turn suggests that poor source memory is simply an expression of generalized episodic memory impairment. Light (1991, p. 350) pointed out that studies in which younger and older adults were tested for contextual detail "have often failed to assess memory for the target information, leaving open the possibility that older adults remember less contextual information because they remember less target information."

Although age-related differences in remembering the content of experimentally studied information have been clearly established (see Craik & Jennings, 1992; Light, 1991; Salthouse, 1991, for reviews), the evidence with respect to
age-related differences in source memory is mixed. For example, in Hashtroudi et al. (1989) study, item recognition of older adults’ was also impaired relative to young adults. Similarly, Cohen and Faulkner (1989), Janowsky, Shimamura, and Squire (1989), Kaulser and Puckett (1981), and McIntyre and Craik (1987) reported age-related source memory decrements under a variety of experimental conditions, but in conjunction with substantial impairments of item memory.

By contrast, studies by Ferguson et al. (1992), Hashtroudi et al. (1994), Schacter, Kaszniak, Kihlstrom, and Valdiserri (1991), and Schacter, Osowiecki, Kaszniak, Kihlstrom, and Valdiserri (1994) reported differential age-related decline of memory for items and for the context associated with acquisition. For example, Schacter et al. (1991) used a variant of the fictitious-facts paradigm developed by Schacter, Harbluk, and McEachlan (1984), and examined younger and older adults’ memory for novel facts that had been read to them by one of two experimental sources either in a random or in a blocked order. Schacter et al. (1991) found that when item (fact) memory was equated between the two age groups (by providing elderly participants with a sufficient number of extra study list exposures), older adults exhibited disproportionate source recall decrements in the blocked condition but not in the random condition. Similarly, Ferguson et al. (1992) found that when multiple cues to the source were made available to the participants, older adults exhibited a source recall decrement under conditions in which their level of item recognition was equivalent to that of young adults. Taken together, experimental and correlational (Craik, Morris, & Loewen, 1990; Shimamura & Squire, 1991) evidence to date indicates that memory for source is, in some conditions, selectively disrupted by aging, although it is not yet clear to what extent source memory is disproportionately impaired relative to item memory in older adults.

When analyzing source failures, two types of errors can be distinguished, source forgetting and source amnesia. Using Schacter et al.’s (1984) terminology, source forgetting can be defined as recall or recognition of an experimentally acquired item that is accompanied by an intraexperimental source error. That means, subjects recall or recognize an item and recollect that it was presented to them earlier in the experiment but attribute it incorrectly to one of several possible experimental sources. Source amnesia is defined as recall or recognition of an experimentally acquired item that is accompanied by an extraexperimental source error. This type of failure occurs when subjects remember an item but fail to recollect that it had been presented by any experimental source and attribute their knowledge to guessing or to an extraexperimental source outside the experiment. The mixed results of age-related differences in source memory are found both in studies of source forgetting and source amnesia.

Concerning the specific role of contextual information for episodic remembering, there is evidence suggesting that memory for source may be a specialized cognitive function that depends on the integrity of the prefrontal cortex. For example, studies of amnesic patients with frontal lobe lesions have revealed marked decrements in memory for source relative to memory for items (Janowsky et al., 1989; Schacter et al., 1984; Shimamura & Squire, 1987). Furthermore, Craik et al. (1990; see also Parkin & Walter, 1992) found that performance in tasks considered as sensitive to frontal lobe functioning, such as Wisconsin Card Sorting Test (WCST) and word fluency, were correlated with degree of source amnesia in healthy old adults. By contrast, in the more recent studies of Spencer and Raz (1994) and Dywan, Segalowitz, and Williamson (1994), measures of frontal lobe functions did not predict source memory performance.

One reason for the mixed evidence with respect to age-related differences in source memory (and frontal lobe functions) may be that most relevant studies have regarded “old” participants as a homogeneous group of individuals who have been contrasted with a relatively selected sample of “young” adults (typically undergraduate students). Considering that several authors have emphasized the importance of a detailed description of (preferably large) participant samples in cognitive aging research (e.g., Maddox, 1987; Rice & Meyer, 1988; Salthouse, Kaulser, & Sauls, 1988; see also Salthouse, 1991), the present study examined the relation between item and source recall by using population-based samples of adults. Thus, instead of comparing groups of “young” and “old” participants, we attempted to obtain a more fine-grained description of the relation between age and source recall by involving a population-based sample of adults from 10 different cohorts of 35–80 years of age.

The research reported is based on the first wave of data collection from the Betula project, which is a longitudinal population-based study on memory, health, and aging, described in detail elsewhere (Nilsson et al., in press). The participants in this first wave of data collection were 100 individuals in each of 10 age cohorts, 35, 40, 45, 50, 55, 60, 65, 70, 75, and 80 years of age when tested. The data collected included subjective and objective assessments of health status, information about socioeconomic background, and a variety of measures of memory function. Given the fact that the participants are representative of large age cohort populations, observed age differences in memory performance should closely estimate the differences in memory functioning for the entire populations. In essence, this possibility to generalize the results to populations across adulthood and old age means that the present study has a high external validity. Disregarding for the moment the possibility that random sampling of subjects may mean a lower internal validity because of covariation with other variables, like education, it is argued that population-based data of this sort should be valuable. Generally, these data have the potential of telling the scientific community much about aging and memory. Moreover, the availability of such a large sample of adults ranging in age from young adulthood to late life is unique and has the potential of confirming or disconfirming previous findings reported in the literature.

To examine age-related differences in source recall, we used a modified version of the fictitious-facts paradigm developed by Schacter et al. (1984; see also McIntyre & Craik, 1987; Spencer & Raz, 1994). In Schacter et al.’s study, the participants studied made-up facts about unknown and well-known people. These statements were presented by one of two experimenters, thereby providing two sources of information within the experiment. In our study, participants
either heard or saw statements about well-known or unknown people during the first phase of the experiment. Each statement was presented in one of four experimenter-defined sources, so that the auditorily presented items were spoken either by a male or female voice, and the written statements were presented on a red or yellow card. Item-memory was subsequently tested by presenting questions about the facts presented in the original statements, along with (distractor) questions referring to well-known and unknown persons. In this way, a correct response could be either learned in the context of the experiment or have its origin from knowledge acquired at another place and occasion than the experiment.

METHOD

Participants. — One hundred individuals from each of 10 age cohorts (35, 40, 45, 50, 55, 60, 65, 70, 75, and 80 years of age) participated in the study. Participants were recruited through the population registry in Umeå, a city of about 100,000 inhabitants in northern Sweden. The sampling procedure is described in detail in Nilsson et al. (in press). Briefly, sampling in each cohort was random, with the restriction that persons with severe sensory handicap (e.g., blindness), organic disease known to affect brain function (e.g., dementia), or mental retardation (e.g., Down’s syndrome) were excluded. As well, only native Swedish-speaking persons were included in the study sample.

In order to achieve a sample of 100 persons per cohort (N = 1000), a total of 1976 persons were contacted via letters. Reasons for not participating in the study among those who were initially targeted included: (a) refusals (n = 498), (b) failure to reach the person by telephone to make appointment for testing (n = 259), (c) disease (e.g., heart disease, sensory handicap, dementia, mental retardation; n = 184), and native tongue other than Swedish (n = 35). The final study sample was compared with those who were targeted but did not participate, as well as the population of Sweden in general in the same age cohorts, with regard to a variety of demographic variables. These variables included gender, marital status, employment, education, income, number of persons living in household, profession, number of children living at home, type of housing, and overcrowding in household (Statistiska Centralbyran, 1985). Importantly, there were no differences among the three groups in question in any of the demographic indices (p > .05), indicating that the study sample was representative of the population.

All participants were assessed in two sessions, one week apart. The first session involved an extensive health examination, including blood samples, an interview concerning health status, questionnaires concerning social variables and critical life events (Ferris, 1984–c), and a revised version of the Katz ADL index (Hultcr-Asberg, 1984). Some cognitive tests were also administered in this session. The second session was devoted exclusively to assessment of memory and other cognitive functions. Each session lasted for approximately two hours. Background information describing each age cohort is summarized in Tables 1 and 2 (see also Appendix, Note 1).

Materials and procedure. — The stimulus materials comprised 10 fictitious facts about well-known persons, such as “Ingmar Bergman was a sailor before becoming a director” and 10 fictitious facts about unknown people, such as “Lars Borg always eats oatmeal for breakfast.” In addition, a set of 40 questions referring to fictitious facts of well-known and unknown persons were used as test items. Half of these test questions referred to the statements presented during the study phase, whereas the remaining (distractor) items referred to generally known or fabricated facts about well-known and unknown persons who were not included in the study statements.

The participants were first informed that the purpose of the study was to examine memory for facts about people. They were instructed to memorize auditorily and visually presented statements about well-known and unknown people. After confirming that each participant had understood the nature of the task, the 20 statements were presented at a rate of 5 sec per item. Each statement was presented in one of four possible sources, so that the auditorily presented items were spoken either by a male or female voice, and the written statements were presented on a red or yellow card. The order of presentation was random, except that no more than three visual or auditory presentations occurred in succession. After the study phase, the 40 questions were given as a test. Half of the questions were about the studied statements (e.g., “What was Ingmar Bergman’s profession before becoming a director?”), whereas the remaining questions were distractors in the sense that they did not refer to the studied items. Half of these distractor questions had well-known answers for people living in Sweden (e.g., “Where was Ingemar Stenmark born?”). These questions were used here only as distractors to the studied items, but they can also be seen as a test of general knowledge or semantic memory (see Nilsson et al., in press; Nyberg, Bäckman, Erngrund, Olofsson, & Nilsson, 1996). The remaining distractors were fabricated questions about unknown people. The test questions were presented in a random order, and for each question the experimenter also asked about the source of the knowledge, i.e., how a given answer had been acquired. Specifically, the experimenter presented the subject with a list of 10 potential sources. These included four within-experiment alternatives (presented visually on red or yellow card, presented auditorily by male or female voice), five extraexperimental alternatives (learned in school; read in newspaper, magazine or book; heard on radio or seen on TV; heard from friends or neighbors; learned in any other way), and a guessing alternative. Omission of a source response was accepted if any of these alternatives was found to be inappropriate. The participants responded verbally, and the experimenter registered their responses. The test was self-paced and took no more than 10 minutes to complete.

RESULTS

The recall data were subjected to five main analyses. First, the mean proportion of correctly recalled items was analyzed as a function of age and item type. The second analysis concerned source recall and was based both on overall source recall and responses conditionalized on correct item recall. The third main analysis dealt with source amnesia,
Table 1. Subject Characteristics Across Age

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*MMSE, Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975).
Word comprehension test, a 30-item multiple-choice synonym test.
Block design, Wechsler Adult Intelligence Scale (Wechsler, 1981, Revised version).
TSH, thyroid-stimulating hormone.

Table 2. First-order Correlation Matrix of Subject Characteristics

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<th>Word Comprehension</th>
<th>Block Design</th>
<th>Word Fluency</th>
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<th>Vitamin B12</th>
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</tr>
<tr>
<td>MMSE</td>
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<td>-0.030</td>
<td>0.336**</td>
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<tr>
<td>Word comprehension</td>
<td>-0.336**</td>
<td>-0.026</td>
<td>0.517**</td>
<td>0.452**</td>
<td>1.000</td>
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</tr>
<tr>
<td>Block design</td>
<td>-0.584**</td>
<td>-0.092**</td>
<td>0.513**</td>
<td>0.454**</td>
<td>0.547**</td>
<td>1.000</td>
<td></td>
<td></td>
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<tr>
<td>Word fluency</td>
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<td>-0.075**</td>
<td>0.369**</td>
<td>0.340**</td>
<td>0.545**</td>
<td>-0.402**</td>
<td>1.000</td>
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<td>Systolic blood pressure</td>
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<td>-0.055</td>
<td>-0.397**</td>
<td>-0.220**</td>
<td>-0.248**</td>
<td>-0.360**</td>
<td>-0.139**</td>
<td>1.000</td>
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<tr>
<td>Diastolic blood pressure</td>
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<td>-0.218**</td>
<td>-0.139**</td>
<td>-0.126**</td>
<td>-0.114**</td>
<td>-0.094**</td>
<td>-0.627**</td>
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<td>0.083**</td>
<td>0.067**</td>
<td>0.083**</td>
<td>-0.109**</td>
<td>-0.037</td>
<td>-0.044</td>
<td>-0.008</td>
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<tr>
<td>TSH</td>
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<td>-0.089**</td>
<td>-0.062**</td>
<td>-0.050</td>
<td>-0.078**</td>
<td>-0.048</td>
<td>-0.036</td>
<td>-0.010</td>
<td>-0.003</td>
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<td>1.000</td>
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<tr>
<td>Folic acid</td>
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<td>-0.164**</td>
<td>-0.036</td>
<td>-0.015</td>
<td>-0.068**</td>
<td>-0.037</td>
<td>0.018</td>
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<td>-0.021</td>
<td>0.180**</td>
<td>-0.001</td>
<td>1.000</td>
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<tr>
<td>Albumin</td>
<td>-0.246**</td>
<td>-0.068*</td>
<td>0.195**</td>
<td>0.068*</td>
<td>0.063**</td>
<td>0.138**</td>
<td>0.057</td>
<td>-0.098**</td>
<td>-0.055</td>
<td>0.024</td>
<td>0.058</td>
<td>-0.095**</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01.
namely, the proportion of source responses referring to situations in which participants failed to remember that an item was acquired from any of the experimental sources and attributed it to guessing or to a source outside the experiment. In all analyses of variance (ANOVAs), a 10 (Age cohort) × 2 (Type of item) mixed factorial model was used, with type of item (well-known vs unknown persons) as a within-subjects factor and age as a between-subjects factor. Subsequent a posteriori analyses were based on Tukey’s tests, and an alfa level of 1% was used for all statistical analyses. Furthermore, separate estimates of power (\( \omega^2 \)) were included in the statistical analyses (Hays, 1981, p. 349). In the fourth main analysis, we examined whether age-related differences in source recall were disproportionately impaired in relation to item memory. To this end, source recall was used as a criterion variable in a hierarchical regression analysis, with item recall, age, and a selection of background variables as predictors. Finally, to obtain a more extensive examination of the influence of individual differences in the demographic, psychometric, and biological variables on source recall, we carried out multiple regression analyses on the source recall and source amnesia data, respectively.

**Item Recall**

Figure 1 summarizes the proportion of correctly recalled items as a function of age and item type. What is readily apparent in these data is that facts about well-known persons were better remembered than those about unknown persons and that item recall decreased as a function of age for both types of items. An ANOVA confirmed these observations by revealing significant effects of age, \( F(9,990) = 15.12, M_{S_e} = .04, \omega^2 = .05 \), and item type, \( F(1,990) = 2002.01, M_{S_e} = .02, \omega^2 = .35 \). No other effects were observed.

Tukey’s a posteriori tests for correctly recalled items showed that 35-year-olds performed significantly better than the 55–80-year-olds. Furthermore, participants 40 years old had better performances than those 60–80 years old, and the 45-year-olds performed better than the 70–80-year-olds. Finally, the 50–65-year-olds were superior to those 80 years old.

**Source recall.** — Figure 2 displays overall source recall performance as a function of item type. These data indicate that source recall of facts related to well-known persons was better than that related to unknown persons, \( F(1,990) = 1011.48, M_{S_e} = .02, \omega^2 = .24 \), and, more importantly, that the level of performance decreased as a function of age, \( F(9,990) = 29.74, M_{S_e} = .03, \omega^2 = .11 \). Furthermore, the interaction between age and type of item was significant, \( F(9,990) = 4.26, M_{S_e} = .02, \omega^2 = .01 \). Subsequent analyses revealed that this interaction was due to the fact that for unknown, but not for well-known items, the 40-year-olds and younger performed better than those 60 years old and older.

Figure 3 presents source recall conditionalized on correct item recall. As with the nonconditionalized data, an ANOVA revealed significant main effects of age, \( F(9,990) = 17.61, M_{S_e} = .02, \omega^2 = .07 \), and item type, \( F(1,990) = 786.04, M_{S_e} = .01, \omega^2 = .21 \), as well as an interaction
between age and type of item, \( F(9,990) = 2.59, MS_e = .01, \omega^2 = .01 \). A possible source of this interaction might be a floor effect for subjects in the older age cohorts. A posteriori tests for items about well-known persons revealed that the 35–45-year-olds performed significantly better than those in the age group of 65–80 years, and those 50–60 years old had better performance than those 80 years old. The corresponding analyses of the data on unknown items showed that participants in the age group 35–40 years old performed better than those between 55–80 years, and the 45–50-year-olds were superior to those between 75–80 years of age.

**Source amnesia.** — The proportion of source amnesia of correctly recalled items is summarized in Figure 4. The overall pattern of results suggests that the occurrence of source amnesia was more prominent among the 75- and 80-year-olds than younger adults. Furthermore, as can be seen from Figure 4, the level of source amnesia was higher for items about unknown than well-known persons. An ANOVA yielded significant main effects of age, \( F(9,662) = 10.01, MS_e = .05, \omega^2 = .07 \), and type of item, \( F(1,662) = 40.09, MS_e = .03, \omega^2 = .02 \). Also, the interaction between these two factors was significant, \( F(9,662) = 6.02, MS_e = .03, \omega^2 = .02 \). A posteriori tests for well-known items yielded data that the 35–60-year-olds showed significantly less source amnesia than the 80-year-olds. The corresponding tests for unknown items revealed that source amnesia was significantly less frequent among those 35–70 years old than in the ages of 75–80 years. No other significant differences were found.

This result should be interpreted with caution because the source amnesia data were based on a relative measure (proportion source amnesia of correctly recalled items). However, a more detailed analysis of the data indicates that there are age-related differences in source amnesia also measured in absolute terms. The number of cases of source amnesia varied between zero and three for unknown items, and between zero and six for well-known items. The number of individuals showing at least one case of source amnesia for unknown items was very low for participants who were 70 years old and younger (10 cases or less in each cohort). By contrast, the corresponding number of participants showing source amnesia among the 75- and 80-year-olds was 16 and 20, respectively. For well-known items, there were less than 10 participants in each cohort who showed at least one case of source amnesia among the 60-year-olds and younger, whereas the corresponding frequencies for the 65, 70, 75, and 80-year-olds were 16, 13, 19, and 26, respectively.

**Selective age differences in source recall.** — The results summarized in the previous sections suggested that there are age-related differences both in item and source recall. As mentioned earlier, an important theoretical question is whether there are age differences in source recall even when age differences in item recall and background variables have been taken into consideration. To test this notion, we carried out a hierarchical regression analysis with source recall as a regressor. To remove variability due to differences in item recall, the proportion of correctly recalled items was added in the first step of the analysis. Furthermore, measures of the Mini-Mental State Exam (MMSE) and word comprehension were included in the first step (Block 1), followed by age as the final predictor (Block 2). The predictors included in Block 1 were selected on the basis of a separate multiple regression analysis in which the variables summarized in Table 1 were included as predictors and (nonconditionalized) source recall as a regressor. Of all background variables presented in Table 1, only age, MMSE, and word comprehension were significantly related to source recall performance (see Appendix, Note 2). The source recall data were analyzed separately for well-known and unknown items and by using an aggregated measure as a regressor. Because both analyses showed virtually identical patterns of data, only the results of the aggregated data will be reported. These results indicated that age explained 20.5% of the source recall variance when added on the first step of the analysis, \( F(1,998) = 256.90, p < .01 \). This relation was not attenuated when Block 1 (i.e., item recall and the significant contributors to source recall performance MMSE, and word comprehension) was added before the age variable. The partial correlation between age and source recall was \(-.28 \) after controlling for the Block 1 variables, \( r(995) = -.09, p < .01 \). Additional evidence for this selectivity of age differences in source recall compared to item recall is the differences seen in \( \omega^2 \) values for age effects on these two scores. That is, the magnitude of the age effect was less for item recall scores than it was for any of the source recall scores.

**Source recall in relation to individual differences.** — To examine the effects of individual differences in the demographic, psychometric, and biological variables on source recall performance, we carried out multiple regression analysis with source recall (conditionalized on item recall) and source amnesia as regressors, respectively, and the variables summarized in Table 1 as predictors. These analyses were carried out stepwise, so that variables with high nonsignificant \( p \)-values were successively excluded from the regression model until only predictors with significant contributions remained (see Appendix, Note 2). Both types of items were analyzed separately.

The results of the cross-validated regression analyses are
summarized in Tables 3 and 4. These data indicate that age, gender, and word comprehension were the only significant predictors of source recall performance of well-known items, whereas only age and years of education were significantly related to unknown items. It should be noted that no other psychometric or biological variables were significant predictors of source recall performance.

The regression coefficients for source amnesia of well-known and unknown items are summarized in Tables 5 and 6, respectively. Because source amnesia was virtually negligible among younger participants, only the data of the 75–80-year-olds (n = 200) were included in the analyses. Thus, the objective of these analyses was to examine the effects of individual differences in source amnesia among older adults, rather than using age as a separate predictor. As can be seen from Tables 5 and 6, word comprehension was the only significant predictor of source amnesia for well-known items, whereas none of the predictors remained significant in the analysis of the cross-validation sample for unknown items.

DISCUSSION

The objective of this study was to examine age-related differences in source recall by involving population-based

<table>
<thead>
<tr>
<th>Table 3. Regression Coefficients for Source Recall Conditionalized on Item Recall of Well-known Items</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Years of education</td>
</tr>
<tr>
<td>Psychometric</td>
</tr>
<tr>
<td>MMSE</td>
</tr>
<tr>
<td>Word comprehension</td>
</tr>
<tr>
<td>Block design</td>
</tr>
<tr>
<td>Word fluency</td>
</tr>
<tr>
<td>Biological</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
</tr>
<tr>
<td>Vitamin B12</td>
</tr>
<tr>
<td>TSH</td>
</tr>
<tr>
<td>Folic acid</td>
</tr>
<tr>
<td>Albumin</td>
</tr>
<tr>
<td>Note. The negative values of gender indicate that women performed better than men. *p &lt; .05; **p &lt; .01.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Table 4. Regression Coefficients for Source Recall Conditionalized on Item Recall of Unknown Items</th>
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<tbody>
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<td>Systolic blood pressure</td>
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<tr>
<td>Diastolic blood pressure</td>
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<tr>
<td>Vitamin B12</td>
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<tr>
<td>TSH</td>
</tr>
<tr>
<td>Folic acid</td>
</tr>
<tr>
<td>Albumin</td>
</tr>
<tr>
<td>*p &lt; .05; **p &lt; .01.</td>
</tr>
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</table>
samples of healthy adults between 35 and 80 years of age. Furthermore, the participants of this study were carefully chosen to be free from clinically diagnosed cognitive or psychiatric problems and were screened on a variety of demographic, psychometric, and biological variables.

The results of this study revealed clear age effects both in item and source recall, thereby replicating earlier studies that have used more traditional sampling procedures and age ranges (e.g., Cohen & Faulkner, 1989; Hashtroudi et al., 1989; McIntyre & Craik, 1987; Schacter et al., 1991). More importantly, the present findings indicated that memory for source, compared to item memory, is selectively disrupted by aging. In other words, age differences in source recall were reliable even when differences in item recall and other relevant variables were taken into account. This result is consistent with those of Ferguson et al. (1992), Hashtroudi et al. (1994), Schacter et al. (1991, 1994), and Spencer and Raz (1994), and suggests that an age-related difference in source memory is not only an expression of generalized impairment of episodic memory.

Concerning source recall failures, participants attributed relatively few target items to an extraexperimental source

Table 5. Regression Coefficients for Source Amnesia of Well-known Items

<table>
<thead>
<tr>
<th>Variable</th>
<th>Validation Sample (first step)</th>
<th>Cross-Validation Sample (final step)</th>
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<tbody>
<tr>
<td></td>
<td>b</td>
<td>Beta</td>
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<tr>
<td>Demographic</td>
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<tr>
<td>Age</td>
<td>.005</td>
<td>.048</td>
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<tr>
<td>Gender</td>
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<td>Years of education</td>
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<td>-.109</td>
</tr>
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<td>Psychometric</td>
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<tr>
<td>MMSE</td>
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<td>.014</td>
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<td>Word comprehension</td>
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<tr>
<td>Block design</td>
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<td>-.105</td>
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<tr>
<td>Word fluency</td>
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<td>.147</td>
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<tr>
<td>Systolic blood pressure</td>
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<tr>
<td>Diastolic blood pressure</td>
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<td>.211</td>
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<tr>
<td>Vitamin B₁₂</td>
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<td>-.120</td>
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<tr>
<td>TSH</td>
<td>.045</td>
<td>.271*</td>
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<td>Folic acid</td>
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<td>-.108</td>
</tr>
<tr>
<td>Albumin</td>
<td>-.006</td>
<td>-.048</td>
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</table>

Note. N = 200; age cohorts 75–80 years.
*p < .05; **p < .01.

Table 6. Regression Coefficients for Source Amnesia of Unknown Items

<table>
<thead>
<tr>
<th>Variable</th>
<th>Validation Sample (first step)</th>
<th>Cross-Validation Sample (final step)</th>
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<tr>
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<td>Gender</td>
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<td>Years of education</td>
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<tr>
<td>Psychometric</td>
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<tr>
<td>MMSE</td>
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<td>.074</td>
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<tr>
<td>Word comprehension</td>
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<td>-.351</td>
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<td>Block design</td>
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<td>Word fluency</td>
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<td>TSH</td>
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<tr>
<td>Folic acid</td>
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<td>-.029</td>
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<tr>
<td>Albumin</td>
<td>.015</td>
<td>.100</td>
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Note. N = 200; age cohorts 75–80 years.
*p < .05; **p < .01.
In conclusion, our study is in accordance with a growing body of research suggesting small or nonexistent age differences in processes relying on activation of preexisting knowledge representations, but impaired processing of contextual detail in old age. The present findings, taken together with relevant past research, suggest that age differences in thyroid-stimulating hormone (TSH) accounted for the source amnesia variance in the first steps of the analyses, but this effect disappeared in the subsequent analysis of the cross-validation sample. Thus, none of the biological variables used here were significant predictors of source recall performance. A reasonable explanation of the absence of effects is that the biological measures were within normal ranges for the age groups examined (see also Wallin, Bäckman, Mäntylä, Herlitz, Viitanen, & Winblad, 1993).

One ambition of the present study was to extend the exploration of a research question on aging and memory, most frequently explored in studies involving one group of young and one group of old subjects, to data from subjects who are randomly sampled from a large population. Such an ambition is certainly in line with a seemingly increasing wish in the research community to base research on aging on representative samples from larger populations (e.g., Baltes, Mayer, Helmchen, & Steinhagen-Thiessen, 1993; Hultsch, Herzog, Small, McDonald-Misczak, & Dixon, 1992; Maddox, 1987; Rowe & Kahn, 1987). What we claim to have accomplished by using a representative sample in the present study is a higher degree of external validity than usually is the case in studies of source recall in relation to age.

The present study is consistent with the notion that older adults rely primarily on processes that place minimal demands on cognitive resources, and therefore pay increasing attention to schematic information at the expense of distinctive or idiosyncratic detail information (Craik & Byrd, 1982; Hess, 1984; Mäntylä & Bäckman, 1990, 1992; Rabinowitz & Ackerman, 1982, but see also Light, 1991). Relating this view to the present study, older adults focused their attention on the focal elements of the study episode (i.e., the statement), rather than involving more elaborate analyses in which different contextual attributes (including the experimenter-defined "sources") were integrated with the focal event.

As a support for this notion, Mäntylä and Bäckman (1992) reported a study in which younger and older adults viewed objects in a real-world setting (i.e., an office room). The stimulus objects were familiar objects that were either consistent (e.g., a telephone) or inconsistent (e.g., a mixer) with expectations. A standard recognition test on item information (i.e., distractors were defined by their semantic identity) revealed that younger and older adults recognized unexpected items better than expected items, indicating that both age groups detected inconsistencies in the experimental setting. However, when a more detailed discrimination was required by requesting recognition of token information (i.e., distractors were defined by their physical appearance), younger adults showed significantly better memory for contextual details than older adults. Furthermore, under divided attention, young adults revealed a similar pattern of results as did elderly adults under full attention, suggesting capacity-related differences in memory for contextual information.

In conclusion, our study is in accordance with a growing body of research suggesting small or nonexistent age differences in processes relying on activation of preexisting knowledge representations, but impaired processing of contextual detail in old age. The present findings, taken together with relevant past research, suggest that age differences in
source recall are, in part, due to less distinctive encoding on the part of older adults. Whether these differences should be conceptualized in terms of an age-related reduction of mental resources, speed, or some other hypothetical mechanism continues to be an issue open to theoretical debate (Craig & Salthouse, 1992; Light, 1991; Salthouse, 1991).

ACKNOWLEDGMENTS

This research was supported by the Bank of Sweden Tercentenary Foundation, the Committee for Planning and Coordination of Research, the Swedish Council for Research in the Humanities and Social Sciences, and the Swedish Council for Social Research. We thank Bente Karlsson, Sig Stig Karlsson, Maria Sandbaum-Åström, and Maud Widing for their assistance in collection of the source recall data.

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